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ABSTRACT

In order to keep abreast of the demands of the modern age, small colleges are turning to new forms of decisionmaking through the use of management information systems. Such systems are used for not only administrative purposes, but for research and instructional purposes as well. Six major options are presently available to small colleges regarding the use of computerized management information systems: (1) off-campus computers with no local terminals; (2) terminals to off-campus computers; (3) cooperative use of a computer with no terminals; (4) mini to small computers on campus; (5) cooperative use of computers via terminals; and (6) on-campus computers with communication capabilities. Most small colleges cannot afford an adequate computer system, the necessary software, and trained personnel. However, the National Laboratory for Higher Education has developed at least a partial solution to this problem. The NLHE Information System is an operational computer software package designed for a small computer that requires no additional programming to generate management information. Implications for the future of this system are described. (HS)

Administration and Organization

TOPICAL PAPERS AND REPRINTS NO. 3
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THE ROLE OF COMPUTERS IN SMALL COLLEGE MANAGEMENT

□ Bruce K. Alcorn

During the last decade and a half the management of the institutions of higher education has been involved in a "revolution" according to Rourke and Brooks. They go on further to say:

Four areas of change stand out as being particularly significant in the emerging style of university administration. The first is the shift from secrecy to publicity in the general conduct of administrative and academic affairs—a shift which has greatly altered the relationship between institutions of higher education and their environment. The second is the development, sometimes institutionalized and sometimes highly informal, of a cabinet style of government in place of the presidential system of executive leadership that has tradition. The third is the introduction of new forms of decision making which, if not entirely as rational as their advocates might suggest, are nonetheless considerably less subjective than the purely intuitive styles of the past. Fourth, and finally, the multicampus network that has been created in many state systems of higher education has generated both novel administrative forms and new difficulties as the world of higher education seeks to adjust to the demands of the modern age.[1]

They also identified the three-fold etiology of these changes as, outside pressures (concern over the rising costs of education and a move toward extra-institutional responsibility), new management tools, and rapidly increasing enrollments and expanding campuses.

These changes, which were at first apparent only in the large universities, are now evident in many of the small colleges. It is conceivable that institutions which successfully adapt to "the demands of the modern age" will, in fact, be those characterized by the four changes cited.

The purpose here is to look at the third change—the new forms of decision making rather than the process itself—as it relates to the small college.

MANAGEMENT INFORMATION SYSTEMS

The term Management Information Systems (MIS) is very often misused in higher education. Many people who talk about MIS have not stopped to define the words management, information, or system, let alone MIS. In addition, it is more often than not simply a concept rather than an operational practice in many colleges and universities. Nonetheless, it is a very useful concept and educational institutions are closer to realizing at least parts of a management information system than ever before. Pinnell put it in a proper context when he said: "I strongly believe that a large measure of the solution to our mounting problems in higher education may be found in the proper application of scientific management techniques to college and university administration." [2]

Defining MIS in a college setting is difficult. Taking the words one at a time, "the term 'management' has traditionally been considered the very antithesis of the community of scholars concept. Their concept holds that no one person, or group should 'manage' anyone in this cooperative endeavor." [3] In spite of this attitude, college administrators *are*, in fact, managers and in order to be effective and to be able to make the correct decisions at the right times they must have a certain information available to them.

The term ". . . 'system' can be defined as a complex of elements stand-

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ing in interaction. These are general principles holding for systems, irrespective of the nature of the component elements and of the relations or forces between them." [4]

Management needs a system whereby information is made available to them for the decision making process. Such a system, regardless of how crude, is a management information system. A further distinction is made between administrative data and management information.

Used in the context of MIS, Hamblen explains that management, as opposed to administration, implies "disconcerning" or "well-advised." He further emphasizes that *management information* "must usually be concise summaries, analyses, digests, charts, etc., of volumes of data, "whereas" administrative data consists of the data used on a day-to-day basis."[5] From this, a definition of a management information system can be generated. *A Management Information System is a set of procedures, people, equipment, and materials (a complex of elements) which, when operating together (standing in interaction) collects administrative data and transforms it into management information for the purpose of allowing institutional decisions to be made with timelines and accuracy.*

Colleges, even the smallest, have always had administrative data and they have all made institutional decisions. On the other hand, few have been able to make decisions based upon management information as opposed to administrative data. Even though the concept of a MIS is not dependent upon computers per se, an operational MIS is in most cases.

By the time the newer management principles started to be accepted in institutions of higher education the necessary computer hardware was present, at least on the larger campuses. This still is not the general picture at the smaller colleges, although the picture is rapidly changing. Currently the most serious roadblock to achieving an operational management information system on a small college campus (assuming the necessary hardware is present) is the lack of the necessary computer software, and related programming and systems analysis personnel.

The principles of management information systems are available to the small college, but it lacks the hardware, software, and personnel to put these principles into practice.

COMPUTERS

Options

Advancing technology has rapidly increased the number of options for institutions of higher education to obtain computing capability. Systems range in purchase price from several thousand to many millions of dollars. Actual system determination should be based upon the type of institution (liberal arts, technical, business, general, etc.) and the resources available (students, staff, and funds).

For the small college the options are limited, but there are several promising alternatives. [6] The following list of options is basically sequential in terms and costs and capability, although the latitude within each is such that a great deal of overlapping exists.

1. *Off-Campus Computers; No Terminals*—Colleges have used the computers at other educational institutions, governmental agencies, or commercial organizations by physically transporting the data and/or users to and from the campus. This type of service has usually been thought of as temporary, or specialized, at best.

2. *Terminals to Off-Campus Computer*—Slow speed inexpensive terminals to a computer at a university or a commercial vendor have been quite successful under the proper situations.[7]

Under this arrangement the distance between the terminal and the central computer, and the type of use can cause problems. If the distance exceeds one hundred miles (a rule-of-thumb) the communication costs may exceed the computer charges, especially if regular telephone rates are in effect. Administrative data processing is generally not as practical within this option as it is in other high input/output applications.

3. *Cooperative Use of Computer; No Terminals*—There are many areas of the country where several small colleges are in very close proximity to each other. In such instances, sharing one facility can sometimes offer better and more flexible service than that provided by the previous option.[7] The reason this procedure is not very popular is that in actual practice it is generally very difficult for such institutions to actually cooperate in major undertakings of any kind.

4. *Mini to Small On-Campus Computer*—This is probably the most popular option in use today since it gives the college some computing ability and it also gives them "their own" computer.[7]

While there is no standard formula as to what constitutes a mini computer as compared with small, medium and large, one reference classifies them in the following manner:

Table 1

COMPUTER SYSTEM CLASSIFICATION BY COSTS [8]

Computer Size	*Monthly Rental*
Mini	under $1,200
Small	$1,200-5,000
Medium	$5,000-40,000
Large	$30,000-150,000

The total annual operating costs for systems within this option would probably range from $10,000-$60,000. The hardware would typically range from an 8K system with teletype I/O plus one symbolic and one compiler language, all the way up to a 16K system with disk or tape, card reader and punch, line printer, plus multiple language capability. The smaller of these would be batch systems while still others might have some time-sharing abilities.

5. *Cooperative Use of Computer; Via Terminals*—The advantages of this over Option 3 is that each institution has "something" on campus. At the small college level one college usually houses the central system and sells "time" to the others making this arrangement the schools hold joint ownership. There are a number of large scale examples of this option, the first being the Triangle Universities Computation Center (TUCC) in Research Triangle Park, North Carolina.

6. *On-Campus Computer with Communication Capability*—This option ranges in hardware from the high speed remote batch terminal to the so-called "intelligent" terminals to a small computer (such as the medium to large sized described in Option 4) which can serve as terminals to a large scale machine. While this option does provide increased flexibility, costs/benefit situations must be carefully examined.

Status of Usage

Small colleges are hard put to justify separate computer centers for administrative and instructional uses. The very small colleges should consider handling administrative data processing off-campus at a service bureau or even manually.

Two recent studies by Hamblen report on computer uses at large and small colleges.[9, 10] A review of the study material reveals certain changes in computer usage at institutions of various sizes. Tables two through eight explicate some of these changes.

For purposes of comparison, it should be noted at this point, that the *small college*, as defined here, is an institution of higher education offering no degree above the bachelor's and having an enrollment of less than 2,500 students.

Table 2 gives the number of institutions of higher education by two enrollment categories and four degree levels. In the fall of 1966 there were 1,413 small colleges which means that 57 percent of all institutions of higher education fell into that category. For the fall of 1968 these figures increased to 1,664 small colleges or 59 percent.

Table 3 presents population estimates of the number of colleges and universities with access to at least one computer or one on order to be in use by the end of 1967 and 1970. By the end of 1967, 301 of the 980 institutions with computers were small colleges. By the end of 1970, 780 of the 1683 institutions with computers were small colleges as defined here.

Table 2

NUMBER OF INSTITUTIONS BY ENROLLMENT AND HIGHEST DEGREE OFFERED

Fall, 1966	*Highest Degree Offered*				
Enrollment	*Associate*	*Bachelor's*	*Master's*	*Doctorate*	*Total*
Below 2500	630*	783*	297	171	1,881
2500 & over	143	48	211	194	596
Total	773	831	508	365	2,477
Fall, 1968					
Below 2500	846*	818*	317	117	2,098
2500 & over	203	47	236	223	709
Total	1,049	865	553	340	2,807

*Total "Below 2500" and no higher than "Bachelor's": (1966)—1,413; (1968)—1,664.

Table 3

ESTIMATED* NUMBER OF INSTITUTIONS WITH *ACCESS* TO A COMPUTER BY ENROLLMENT AND HIGHEST DEGREE OFFERED [9,10]

1967	*Highest Degree Offered*				
Enrollment	*Associate*	*Bachelor's*	*Master's*	*Doctorate*	*Total*
Below 2500	148**	153**	92	78	471
2500 & over	105	36	182	186	509
Total	253	189	274	264	980
1970					
Below 2500	376*	404*	157	67	1,004
2500 & over	192	42	223	222	679
Total	568	446	380	289	1,683

*Not all institutions answered the questionnaire, therefore these estimates are based upon the assumption that those not responding had access to computers in the same proportion as those institutions responding.
**Total "Below 2,500" and no higher than "Bachelor's": (1967)—301; (1970)—780.

Table 4
ESTIMATED PERCENT OF INSTITUTIONS WITH COMPUTERS BY ENROLLMENT AND HIGHEST DEGREE OFFERED [9, 10]

1967	*Highest Degree Offered*				
Enrollment	*Associate*	*Bachelor's*	*Master's*	*Doctorate*	*Total*
Below 2500	23%	20%*	32%	46%	25%
2500 & over	73%	75%	86%	96%	85%
Total	33%	23%	54%	72%	40%
1970					
Below 2500	44%	49%*	50%	57%	48%
2500 & over	95%	89%	94%	99%	96%
Total	54%	52%	69%	85%	60%

*Total "Below 2500" and no higher than "Bachelor's": (1967)—21%; (1970)—47%.

Table 5
COMPUTERS REPORTED IN USE AT INSTITUTIONS WITH ENROLLMENTS LESS THAN 2500 AND OFFERING AT MOST A BACHELOR'S DEGREE [9, 10]

	Number By End Of			*Number By End Of*	
Type	*1967*	*1970*	*Type*	*1967*	*1970*
Bur E 103	1	0	IBM 1140	0	1
Bur TC 500	0	1	IBM 1401	36	26
Bur 101	1	0	IBM 1440	1	1
Bur 205	3	0	IBM 1460	0	1
Bur 2500	0	2	IBM 1620	49	40
CDC G 15	2	2	IBM 1800	0	2
CDC LPE 30	1	0	IBM 360	1	0
CDC 3800	0	1	IBM 360/20	9	25
CLY DE 60	1	0	IBM 360/25	0	17
DAG SUPNOV	0	1	IBM 360/30	4	17
DEC PDP 8	1	1	IBM 360/40	0	7
DEC PDP 8I	0	11	IBM 360/44	0	1
DEC PDP 8L	0	8	IBM 360/50	0	1
DEC PDP 8S	0	1	MON MARK X1	1	1
DEC PDP 9	0	1	MON 2000	1	0
DEC PDP 11	0	2	MON 3000	1	0
DEC PDP 12	0	2	NCR 100	0	22
EAI 1020	0	1	NCR 200	0	3
GEC 115	1	1	NCR 395	0	1
GEC 225	0	1	NCR 615	0	2
HEP 2000A	0	1	PDS 1020	1	0
HEP 2007	0	1	RCA 301	0	2
HEP 2114	0	1	RCA 70/35	0	3
HEP 2114 A	0	1	RCA 70/45	0	1
HEP 2114 B	0	1	RCA 70/46	0	1
HEP 2116	0	1	UNI ATHENA	1	1
HEP 9100A	0	2	UNI 120	0	1
HEP 9100B	0	1	UNI 422	0	1
HON 115	0	2	UNI 1004	1	1
HON 200	3	3	UNI 9200	0	7
NON 1200	0	1	UNI 9300	1	1
IBM Sys 3	0	7	XDS SIGMA 7	0	1
IBM 1130	48	130	XDS 7670	0	1

The data presented in Table 4 was computed directly from the preceding two tables. While all categories increased between 1967 and 1970, the two representing the small colleges increased the most. The percentage of small colleges having computers more than doubled, the over-all gain was only 50 percent.

Table 5, which shows the variety of computer models in use in the small colleges as well as the number of manufacturers represented, indicates that both the number in use and the variety of models have increased. The share of the market at this level for the leader, IBM, has slipped from 87 percent to 73 percent, with DEC (Digital Equipment Corp.) rising from less than one percent to almost seven percent and NCR going from nothing to just over seven percent.

The estimates of expenditures for computer facilities are given in Table 6. It is interesting to note that according to the 1966-67 study, the small colleges comprised 57 percent of all institutions of higher education, made up 31 percent of the colleges with computers, but were responsible for only 6 percent of the funds expended for computers by colleges and universities. The 1969-70 study, however, has revealed that 59 percent of all higher educational institutions were small colleges, and that they represented 46 percent of the colleges with computers, and expended 9 percent of all funds spent for computers by colleges and universities.

Types of Usage

Computer usage in higher education can be classified in one or more of three groups: research, instruction, and administration. Because the small colleges often put a low priority on research activities, research computing is usually minimal or nonexistent. In these institutions com-

puters are generally used for instructional or administrative purposes.

Tables 7 and 8 show that of the total number of campus computer installations (often there are multiple installations on a given campus) only one percent were used for research alone at institutions which offered only the associate or bachelor's degrees; while at the schools offering master's and doctoral degrees, 12 percent of the installations were used only for research computing. This same trend is seen when grouping the institutions by enrollment.

A recently completed experiment [11] involving 20 colleges, all of which meet at least one or both of the criteria for small colleges as used here, provides further evidence of these usage patterns. The following table gives minimums and maximums for the kinds of use (in percentages) by three kinds of computer facilities.

Whether instructional uses or administrative applications are most prominent depends upon several factors and their interactions. One such factor is the type of computer system, as illustrated in the previous table. Administrative computing in general requires more sophisticated input/output devices than are present with many systems used for instruction. Usually, computers which can be used for administrative problems can also be used for instruction, although the reverse is often not true.

Another factor is people. Administrative data processing generally requires a programming and systems analysis staff, whereas instructional computing can often be done by the students and faculty. In other words, administrative work is generally more costly as long as simulation—Computer Assisted Instruction and Computer Management Instruction—are not involved in the comparison.

In most small colleges there are

Table 6

ESTIMATES OF EXPENDITURES FOR COMPUTERS BY ENROLLMENT AND HIGHEST DEGREE OFFERED IN MILLIONS OF DOLLARS [9, 10]

Enrollment	*Associate*	*Bachelor's*	*Master's*	*Doctorate*	*Total*
Below 2500	8.5*	5.0*	6.2	18.6	38.3
2500 & over	13.0	3.7	20.5	145.6	182.8
Total	21.5	8.7	26.7	164.2	221.1
1969-70					
Below 2500	26.8*	17.9*	11.8	19.1	75.6
2500 & over	36.4	8.4	53.0	298.6	396.4
Total	63.2	26.3	64.8	317.7	472.0

*Total "Below 2500" and no higher than "Bachelor's": (1966-67)—13.5; (1969-70)—44.7.

Table 7

PERCENTAGE OF COMPUTER INSTALLATIONS BY TYPE OF USAGE, HIGHEST DEGREE OFFERED, AND ENROLLMENT [9]

	Type of Usage				
Category	Instruction only	Research only	Administration only	Research and Instruction	Research Admin. and Instruction
Associate & Bachelor's	11%	1%	6%	6%	76%
Master's & Doctorate	3%	12%	15%	25%	45%
Enrollment <5000	7%	4%	11%	11%	66%
Enrollment >5000	4%	16%	17%	33%	57%

Table 8

PERCENTAGE RANGE FOR TYPES OF COMPUTER USE AT THE END OF THE EXPERIMENT [11]

	Research		*Administrative*		*Instructional*	
Type of Computer Facility	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Terminal Only	0%	13%	0%	5%	87%	100%
Small On-Campus Computer*	0%	10%	12%	66%	32%	75%
Sharing Off-Campus Computer**	10%	10%	0%	0%	90%	90%

*One institution had a research use of 32% but it was not included here because half of its students are at the graduate level.

**These institutions have a separate administrative computer center.

two types of instructional use; 1) using the computer as a problem-solving tool and 2) teaching about the computer itself. Table 8 shows the importance attached to instructional use of computers in these institutions.

A PARTIAL SOLUTION

As mentioned earlier, the major roadblock that keeps most small colleges from bridging the gap between administrative data and management information (as defined earlier) is the lack of an adequate computer system, the necessary software, and personnel. The National Laboratory for Higher Education has developed at least a partial solution to this threefold problem. The NLHE Information System is an operational computer software package designed for a small computer that requires no additional programming to generate management information.

The Present

The NLHE Information System is a partial answer; it is not a complete MIS, but it is a good start toward enabling college administrators (managers) to make institutional decisions based upon management information rather than on administrative data alone.

The current version of this generalized information retrieval system (written in FORTRAN, a universal computer language) is operational on an IBM 1130 (minimal 8K configuration) and permits over one million characters of data to be stored on a single disk together with the system itself. In a simple fashion, the system can handle the following processes:

- File creation and maintenance
- Printing a file description table
- Sorting on multiple fields
- Selection of sets and subsets of records (several levels)
- Statistical calculations (frequency distribution, correlation, and tabulation)
- Printing file data, which has been selected, sorted, and statistically summarized, into useful information
- Format control (forms control, card punching, labels, literal data, and title printing)

Instructions are given to the system via control cards which are data independent; i.e., the commands do the same job regardless of the data base.[12]

This system is currently operational at more than 150 educational institutions and has saved close to 1000 programming hours at one college in one application area alone. It is then, more than just a concept, since it works. It also works on a small computer, does not require programming, and therefore helps to bridge the gap between administrative data and management information.

The Future

Since the NLHE Information System was designed for a small computer, its use is somewhat restricted. For instance, it lacks the ability to interact with more than one file at a time, and is unable to perform arithmetic functions outside of the statistical features outlined. Further development, however, will eventually eliminate these restrictions.

Another area of change will be converting the software to other computers. Some of this work is presently underway but in most cases it is not very far along. One exception to this is the version which is currently being tested in a remote batch mode with an IBM 370/165, which will enable small colleges to use the system via a remote terminal.

When these efforts are completed the NLHE Information System will not only be more flexible and powerful, but more institutions of higher education will be able to start making responsible institutional decisions based upon management information.

FOOTNOTES

1. Francis E. Rourke, and Glenn E. Brooks, The *Managerial Revolution In Higher Education* (Baltimore: John Hopkins Press, 1966).

2. Charles Pinnell, "Application of Scientific Management Techniques to College and University Administration," *AEDS Journal*, September, 1968.

3. Robert J. Parden et al, *An Introduction to Program Planning, Budgeting and Evaluation for Colleges and Universities: Proceedings* (Santa Clare: University of Santa Clare, 1970).

4. Ludwig von Bertalanffy, *Problems of Life* (New York: Harper Torchbook Edition, 1960).

5. John W. Hamblen, "From Administrative Data to Management Data," *Management Information For College Administrators*, John D. Bolin, (Athens, Ga.: Institute of Higher Education, University of Georgia, 1971).

6. *Conference on Computers in the Undergraduate Curricula* (Iowa City, University of Iowa, 1970).

7. For some operational examples see: Bruce K. Alcorn, "Computers in Small Colleges", *AEDS Journal*, September, 1971.

8. John W. Hamblen, "Central Computer Center Organization and Computer Systems Options for Institutions of Higher Education," *Proceedings of Conference on Computers in Instruction: Their Future in Higher Education* (Santa Monica: RAND Corp., October, 1970).

9. John W. Hamblen, *Inventory of Computers in U. S. Higher Education, 1966-67* (Washington: National Science Foundation, 1970).

10. John W. Hamblen, *Inventory of Computers in U. S. Higher Education, 1969-70* (Washington: National Science Foundation, 1970).

11. John W. Hamblen and Bruce K. Alcorn, *Computer Facilities For Instruction in Small Colleges: Final Detail Report* (Atlanta: Southern Regional Education Board, 1971).

12. For example, the following control card, SORT 15, tells the system to sort the records in ascending order on field number 15 regardless of the type of data contained in that field.

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